Space Weather Technical Forecast

Issued on Tuesday, 28 June 2022 at 00:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Active electron fluence continuing. Slight chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with one small C-class flare observed. There are five sunspot regions on the visible disk. AR3040 (Cao/Beta) remains the largest region, located in the southern hemisphere near the centre disc. This group was responsible for a C1 flare at 27/1843 UTC. AR3041 (Cso/Beta) near the northwest limb has developed slowly during the period and appears stable at this time. An unnumbered region in the southeast has also grown to become a Cro/Beta group. Two other new Alpha/Axx spots have emerged; one in the southeast and another near the centre disc in the northern hemisphere.

There are considered to be no new Earth-directed CMEs showing on available imagery. The ongoing lack of some SDO data means confidence is low and there remains the possibility weak transient features embedded in the solar wind. A possible filament eruption was indicated in STEREO-A EUVI imagery around 27/1000 UTC, from an area just south of AR3040, though to this point no clear evidence of a CME is present in LASCO imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured at L1, has slowly decreased during the period as coronal hole influences wane, reducing from 630km/s (strong) to around 480km/s (slightly elevated). Density was mostly below average. The Phi angle was predominately negative (towards the Sun). The total Interplanetary Magnetic Field (IMF) was weak, with a peak of 7nT. The North-South component of the IMF, Bz, was initially negative, though became mostly positive from around 27/0545 UTC. Geomagnetic activity was Quiet to Active (Kp 1 to 4).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) as measured by GOES16 remained at Background levels throughout the period. High energy electron flux (greater than 2MeV) rose from Background or Moderate levels up to High from 27/0750 UTC, with a peak of 3640 pfu observed at 27/1610 UTC. The corresponding 24-hour electron fluence rose above the Active threshold (1e8 integrated pfu) from 27/1500 UTC and remained above to the end of the period. An observed fluence of 1.54e8 integrated pfu was recorded at 28/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low or Very Low, with only a slight chance of increasing to Moderate with any M-class flares that occur.

Solar Wind / Geomagnetic Activity: A CME from the 24th is expected to pass just ahead of Earth early on day 1 (28th), but there is a slight chance it may give a glancing blow. No other earth-directed CMEs currently feature in the forecast period. Solar winds are expected to continue to slowly decrease on day 1 and 2 (28th and 29th) as the influence from one or more geo-effective coronal holes wanes; speeds reducing from slightly elevated to background levels. No further significant enhancements to the solar wind are expected through the remainder of the forecast period. Geomagnetic activity is likely to be mainly Quiet, with isolated Unsettled

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

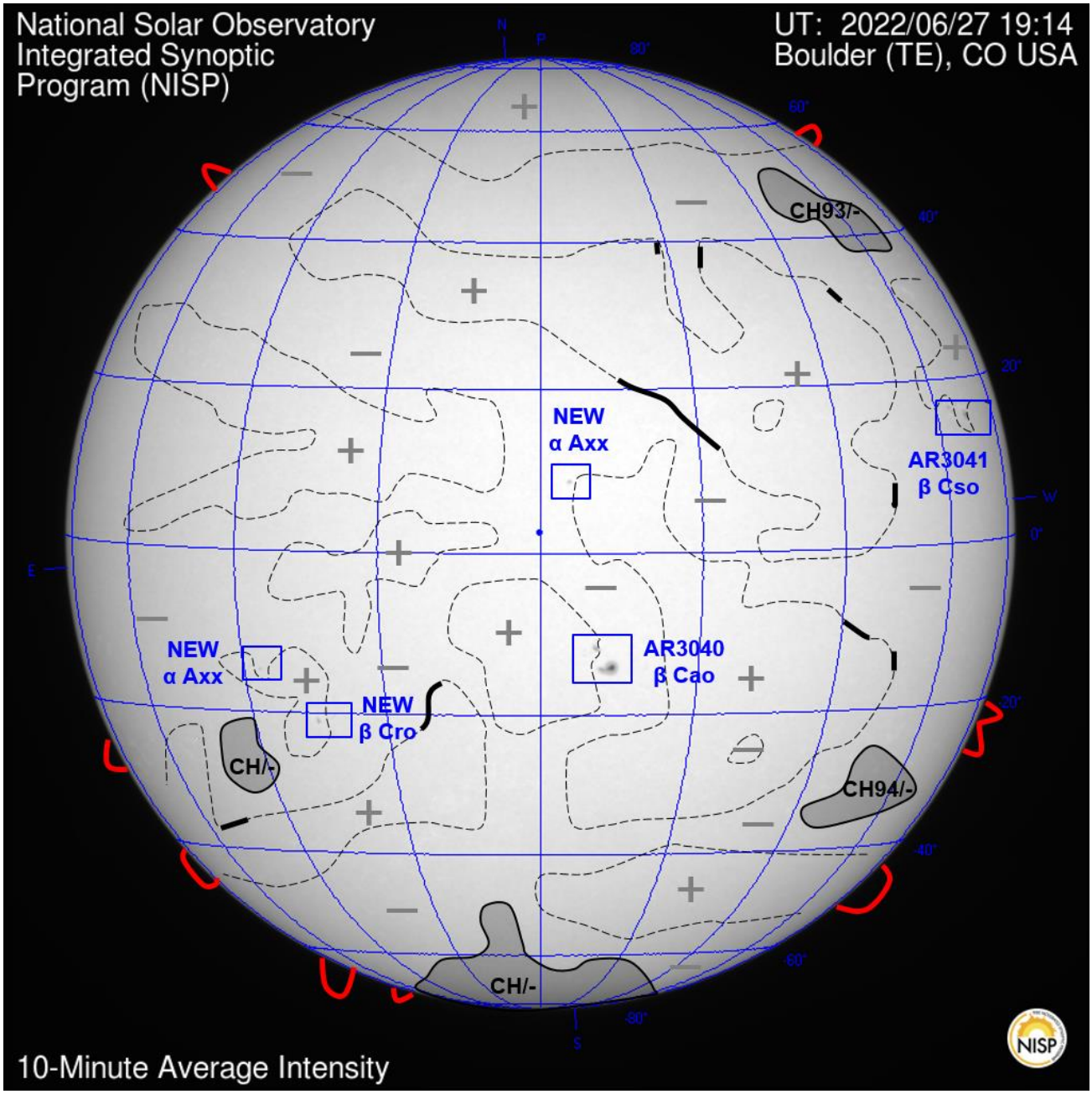
intervals possible through the period and with a slight chance of isolated Active intervals from any possible CME influence on day 1.

Energetic Particles / Solar Radiation: In the absence of any significant sunspot development, the High energy proton flux (greater than 10 MeV) is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) is expected to continue at mainly High levels until at least day 3 (30th), thereafter a drop in electron flux to more persistently Moderate or Background levels appears probable. Any CME glance that occurs early on day 1 (28th) may temporarily lead to a drop out in values, however this is very low confidence and only has a slight chance of occurring. Corresponding electron fluence is expected to remain above the Active (1e8 integrated pfu) fluence level until at least day 3. After this it may lower to Moderate levels, though confidence in this aspect is fairly low.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 1. Solar Analysis Valid 27/1915 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

There are no significant CMEs on the Earth-Sun line, however a filament eruption on the 24th produced a weak CME that was visible on STEREO A cor2 imagery. This has been assessed as passing just ahead of Earth, but may give a glancing interaction early on day 1 (28th), although this assessment is low confidence due to the lack of significant CME signal on SOHO coronagraphs. No other earth-directed CMEs currently feature in the forecast period, however, a possible filament eruption was indicated in STEREO-A EUVI imagery around 27/1000 UTC, from an area just south of AR3040. To this point no clear evidence of a CME is present in LASCO imagery from this event.

Solar winds are expected to continue to slowly decrease on day 1 and 2 (28th and 29th) as the influence from CH93/- and/or CH94/- wanes, reducing from slightly elevated to background levels. No further significant enhancements to the solar wind are expected through the remainder of the forecast period.

Geomagnetic activity is likely to be mainly Quiet, with isolated Unsettled intervals possible through the period and with a slight chance of isolated Active intervals from any possible CME influence on day 1.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections – Nil expected.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

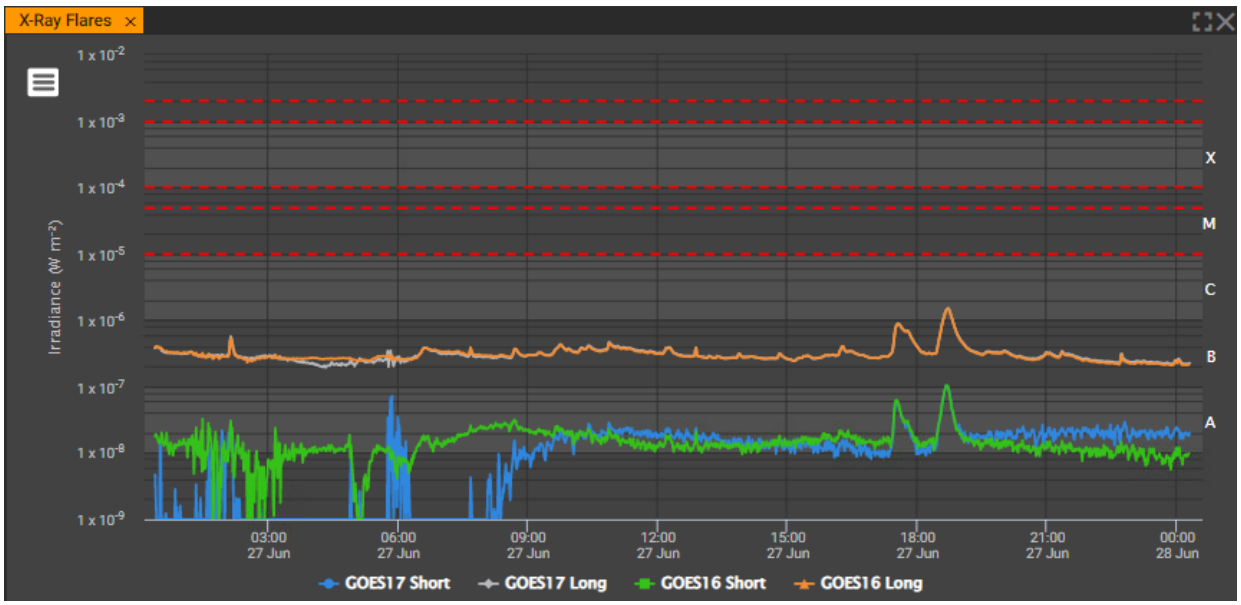
There are currently five sunspot regions on the visible disk. AR3040 (Cao/Beta) remains the largest region, located in the southern hemisphere near the centre disc. This group was responsible for a C1 flare at 27/1843 UTC. AR3041 (Cso/Beta) near the northwest limb has developed slowly during the period and appears stable at this time. An unnumbered region in the southeast has also grown to become a Cro/Beta group. Two other new Alpha/Axx spots have emerged; one in the southeast and another near the centre disc in the northern hemisphere.

Solar activity has been Low over the past 24 hours. Activity is likely to continue at Low to Very Low levels, with only a slight chance of isolated M-flares. AR3041 is expected to rotate off the earth-facing disc in the next day, resulting in a slight lowering of the M-class flare risk from day 1 (28th) to day 2 (29th). Based on STEREO-EUVI imagery there are no new active regions currently expected to rotate onto the earth-facing disc in the next three days.

(Please note, a large amount of SDO imagery is currently unavailable leading to a lack of high-resolution imagery for analysis. Consequently the current solar assessment is based primarily on GONG imagery supported by imagery from GOES SUVI).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 2: GOES16 X-ray flux



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and will most likely remain at this level through the period, in the absence of any significant sunspot development.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux, as observed by GOES-16, reached and remained at High levels from 27/0750UTC onwards.

Electron flux levels are expected to continue at mainly High levels until at least day 3 (30th), thereafter a drop in electron flux to more persistently Moderate or Background levels appears probable. Any CME glance that occurs early on day 1 (28th) may temporarily lead to a drop out in values, however this is very low confidence and only has a slight chance of occurring.

Corresponding electron fluence is expected to remain above the Active (1e8 integrated pfu) fluence level until at least day 3. After this it may lower to Moderate levels, though confidence in this aspect is fairly low. Active levels of fluence were observed around 24 hours later than standard 27-day persistence had indicated, though this and the REFM forecast indicate fluence levels remaining above the Active threshold well into day 3. This gives added confidence to the current forecast.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	90	80	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	3	3	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 3: GOES16 Electron Flux (top) and MOSWOC REFM forecast (lower)

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.